



Budapest University of Technology and Economics  
Faculty of Economic and Social Sciences  
Doctoral School of Business and Management

## **Thesis booklet**

# **Sustainability in Education – Supporting the Feasibility of the Sustainability Transition**

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## **1. Research history**

Within the broad field of sustainability, climate change emerges as a particularly urgent and complex challenge. The reports of the Intergovernmental Panel on Climate Change (IPCC) have long emphasised that the accelerating pace of climate change is primarily driven by human activity, especially the emission of greenhouse gases. These reports highlight the urgent need for a comprehensive, science-based and globally coordinated response to both mitigate climate change and adapt to its effects (IPCC, 2001; 2007; 2014; 2023).

In line with these international efforts, the Paris Agreement (2015), adopted under the United Nations Framework Convention on Climate Change, marks a milestone in global climate policy. Beyond emission reductions and adaptation, the agreement also highlights the role of education, training, public awareness and societal engagement in tackling climate change. This approach aligns with the UN's 2030 Agenda for Sustainable Development (United Nations, 2015b), which sets out seventeen integrated goals to promote social, economic and environmental sustainability. However, according to the UN's 2024 report, only 17% of these goals are progressing as planned, with many indicators showing stagnation or even regression (UN DESA, 2024). The report attributes the slow progress to the compounding effects of the COVID-19 pandemic, geopolitical tensions and the deepening climate crisis, underscoring the need for urgent action.

The transformational changes required to address sustainability challenges effectively can only be achieved through the active engagement of education and innovation. Both have the potential to significantly support the achievement of the UN Sustainable Development Goals (hereafter: SDGs). Education plays a critical role in shaping mindsets and sharing knowledge, and in the age of the knowledge-based economy and society, it is a key tool for addressing sustainability challenges (Kioupi & Voulvouli, 2019; Abera, 2023). Innovation, meanwhile, enables the development of new technologies, strategies and business models and fosters collaboration among diverse stakeholders. It is a powerful instrument for addressing global challenges and advancing the SDGs (Schumpeter, 1934; Schot & Steinmueller, 2018; Mazzucato, 2021). The integration of education and innovation is essential to the practical realisation of sustainability objectives.

## 2. Objectives

The aim of this research is to explore how education and innovation can contribute to the implementation of the Sustainable Development Goals (SDGs). Special attention is given to environmental policy, the educational implications of the digital transition, competence-based approaches, and the alignment of educational provision with labour market demand from a sustainability perspective.

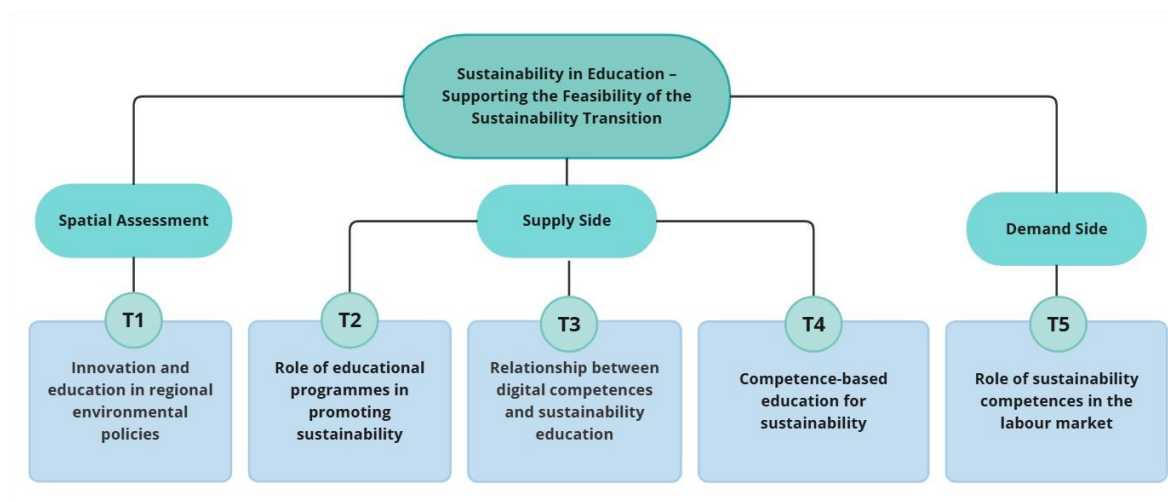
The increasing urgency of climate change and the broader challenges of sustainable development demand that educational systems adapt and incorporate sustainability considerations into learning processes. The central research question is: In what ways can education support climate change mitigation, the development of sustainable strategies, and the achievement of the United Nations Sustainable Development Goals?

The research seeks to address the following specific questions:

**Spatial level – environmental policy focus:** How are education and innovation reflected in selected regional environmental policy documents?

**Supply side – educational programmes and competences:** How can education systems support sustainability, and what competences need to be developed to achieve this?

**Demand side – labour market expectations:** What competences are currently required in the labour market, and to what extent do they align with sustainability-oriented expectations?



1. åbra Structure of the thesis

### **3. Analytical methods**

The research employed a combination of methodological approaches to explore the interconnections between education, innovation and sustainability in a comprehensive manner. A mixed-methods design was adopted, integrating both qualitative and quantitative methods to provide a nuanced understanding of the complexity of the phenomena studied.

The bibliometric analysis was based on publications sourced from the Scopus database, processed using the VOSviewer software. For the theoretical literature review, a broader set of academic sources was used to establish the conceptual foundations of the research.

To assess practical experiences, the study included questionnaire-based surveys, interviews and focus group discussions. The surveys targeted university lecturers and students and examined the development of sustainability competences and green skills, as well as the impact of digital teaching practices during the COVID-19 pandemic. As part of the qualitative data collection, in-depth interviews and focus groups were conducted with stakeholders in higher education and policymaking.

Document analysis focused on two main areas. Firstly, it examined county-level climate strategies in Hungary, analysing the extent to which education and innovation are addressed in strategic objectives and intervention measures. Secondly, it included a comparative content analysis of European competence frameworks, with particular emphasis on transversal skills – that is, competences applicable across multiple fields and life situations – which are especially relevant to sustainability and labour market adaptability.

To investigate labour market expectations, a content analysis was conducted on job advertisements collected at a university career fair. This analysis focused on identifying the competences most frequently mentioned, especially those relating to sustainability and green skills.

The combined use of these methods enabled a multi-level interpretation of educational and sustainability processes and provided a solid basis for the formulation of well-founded conclusions.

#### 4. New scientific findings

The hypotheses formulated during my research were examined through qualitative and quantitative analyses. Based on the review of the literature and the investigations carried out, the following thesis statements may be formulated.

##### T1.

**Successful regional policy responses to sustainability and climate change challenges tend to integrate education and innovation as key components, thereby enhancing adaptive capacity, supporting effective mitigation strategies, and promoting sustainable and competitive regional development. While the literature highlights the importance of embedding education and innovation in regional strategies, the analysis of Hungarian regional environmental policy documents reveals that these elements are generally addressed only at a declarative level. Concrete targets and implementable measures are largely absent, meaning that education and innovation do not currently fulfil a strategic function in fostering sustainable and climate-resilient regional development in Hungary [7].**

Related publication:

Szalmáné Csete, M. and Barna, O. (2021a) Assessment of regional climate innovation potential in Hungary. *International Journal of Global Warming*, 25(1), pp. 1–19. <https://doi.org/10.1504/IJGW.2021.10038668>

The research findings indicate that education and innovation appear only sporadically and at a conceptual level in Hungarian regional development documents. They are rarely supported by concrete measures, and thus neither education nor innovation currently plays a decisive strategic role in shaping sustainable and climate-resilient regional development. The hypothesis is partially confirmed: while the literature review supports the view that successful regional policy responses do in fact integrate both education and innovation, the Hungarian policy documents examined tend to underestimate their importance and fail to employ them consciously to strengthen responses to climate-related challenges.

##### T2.

**The effectiveness of educational programmes and initiatives addressing climate change and sustainability plays a crucial role in preparing future generations to tackle sustainability challenges. Such programmes significantly contribute to the long-term foundations of sustainable development, both in public and higher education. Research**

**findings and literature confirm that educational initiatives in Hungary that focus on sustainability and climate issues are well suited to developing the attitudes and competences necessary for sustainability. These initiatives have the potential to promote meaningful behavioural change and support the achievement of the Sustainable Development Goals [1], [3], [4], [9].**

Related publications:

Szalmáné Csete, M., Buzási, A. and Barna, O. (2020) ‘Climate innovation and entrepreneurship in primary and secondary education in Hungary’. In: Leal Filho, W., Pretorius, R.W. és Shiel, C. (szerk.) *Sustainability in transforming societies: collection of papers from the 26th Annual Conference of the International Sustainable Development Research Society (ISDRS)*. Hamburg: European School of Sustainability Science and Research, pp. 337–350.

Szalmáné Csete, M. and Barna, O. (2020) ‘Innovatív oktatás és fenntarthatóság a klímaváltozás korában’. In: Bujdosó, Z., Dinya, L. és Csernák, J. (szerk.) *XVII. Nemzetközi Tudományos Napok – Környezeti, gazdasági és társadalmi kihívások 2020 után*. Gyöngyös: Károly Róbert Nonprofit Kft., pp. 1107–1113. ISBN 978-615-5969-02-7.

Barna, O. and Szalmáné Csete, M. (2022a) ‘Integrating sustainable competences and green skills in the Hungarian environmental engineering education’. In: Proceedings of the SEFI 2022 50th Annual Conference of the European Society for Engineering Education: *Towards a new future in engineering education: new scenarios that European alliances of tech universities open up*. Barcelona: SEFI, pp. 93–100. Available at: <https://doi.org/10.5821/conference-9788412322262.1430>

Barna, O. and Szalmáné Csete, M. (2023a) ‘Certificate-based good practice to motivate engineering students to learn sustainability skills’. In: *Proceedings of the 51st Annual Conference of the European Society for Engineering Education (SEFI 2023)*. Dublin: Technological University Dublin, pp. 1630–1638. Available at: <https://doi.org/10.21427/0Q5G-DW07>

In this research, I examined the extent to which sustainability and climate-related educational programmes contribute to achieving sustainability objectives. The literature review confirmed that educational initiatives – especially those built around competence development – have a long-term impact on shaping attitudes and behaviours. Based on the Hungarian examples presented in the dissertation, it can be concluded that these programmes are indeed capable of

fostering the skills and mindsets required for sustainability. The hypothesis is therefore largely confirmed.

### T3.

**The results of the research confirm that the effective integration of digital technologies and digital competences can enhance the impact of sustainability and climate change education. At the same time, the digital transition during the COVID-19 pandemic shed light on infrastructural, methodological and social inequalities that hindered equal access to sustainability education in Hungary. [8].**

Related publication:

Barna, O. and Szalmáné Csete, M. (2022b) 'Pandémia alatti online oktatás és hatása a klímaváltozás oktatására'. In: Molnár, D., Molnár, D. és Nagy, A. Sz. (szerk.) *Tavaszi Szél 2022 / Spring Wind 2022 Tanulmánykötet II*. Budapest: Doktoranduszok Országos Szövetsége, pp. 229–244. ISBN 978-615-6457-13-4.

This research explored how the integration of digital technologies and competences influences the effectiveness of sustainability and climate change education, particularly in the context of the digital shift during the COVID-19 pandemic. The large-scale questionnaire survey revealed major differences in students' access to digital devices, teachers' methodological preparedness, and schools' digital infrastructure. These inequalities significantly hindered the effective delivery of sustainability-related content. The hypothesis is confirmed.

### T4.

**Competence-based and multidisciplinary programmes in higher education are well suited to developing sustainability-related, green and transversal skills. The research findings confirm that such programmes foster systems thinking, critical and future-oriented mindsets, and help students prepare for labour market challenges. [2], [6].**

Related publications:

Barna, O. and Szalmáné Csete, M. (2021) Zöld készségek a felsőoktatásban. *Educatio*, 30(4), pp. 682–693. <https://doi.org/10.1556/2063.30.2021.4.9>

Barna, O. and Szalmáné Csete, M. (2024) Competence framework-based assessment to foster sustainability management. *Periodica Polytechnica Social and Management Sciences*. <https://doi.org/10.3311/PPso.22416>

The research placed particular emphasis on examining how higher education programmes contribute to the development of sustainability-related competences. The literature review confirmed that competence-based, inter- and multidisciplinary approaches are particularly effective in fostering systems thinking, future-oriented perspectives and the capacity for action. In addition to the analysis of the Green Certificate programme, both qualitative and quantitative research – including student and teacher feedback – supported the conclusion that such initiatives have a genuine impact on shaping attitudes and improving students’ preparedness for the labour market. The hypothesis is confirmed.

## T5.

**Based on the research findings, transversal competences – particularly those aligned with sustainability-related skills – are gaining increasing importance in the labour market, especially in the field of engineering. Although sustainability is rarely mentioned explicitly in job advertisements, the nature of the desired skills and attitudes suggests that the integration of sustainability competences into higher education programmes can improve graduates’ adaptability and enhance their employment prospects [5].**

Related publication:

Barna, O. and Szalmáné Csete, M. (2023b) ‘Preparing students for the sustainability skill requirements of the engineering labour market’. In: Rasyikah, M.K. et al. (szerk.) *Proceedings of the 29th International Sustainable Development Research Society (ISDRS) Conference 2023: Half-way Through Agenda 2030 – Assessing the 5Ps of SDGs*. Bangi: Faculty of Law, Universiti Kebangsaan Malaysia, pp. 84–94. eISBN 978-967-26554-1-1.

As part of the research, I explored how sustainability-related expectations appear in the labour market, with a focus on the engineering sector. Literature suggests that sustainability and transversal competences – such as critical thinking, collaboration and adaptability – are increasingly valued in the future job market. Content analysis of job advertisements showed that while sustainability is rarely mentioned explicitly, the competences employers seek largely align with those in sustainability competence frameworks. Based on these findings, the hypothesis is substantially confirmed.

## 5. Scientific publications related to the thesis statements

1. Barna, O. and Szalmáné Csete, M. (2021) Zöld készségek a felsőoktatásban. *Educatio*, 30(4), pp. 682–693. Available at: <https://doi.org/10.1556/2063.30.2021.4.9>
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